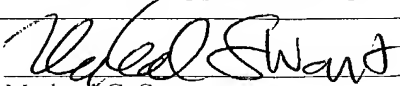


10099314 2050302

By Express Mail # EL489597407US

JC05 Rec'd PCT/PTO 13 MAR 2002

FORM PTO-1390 (REV 10-94)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		DOCKET #: 4925-217PUS
<b>TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371</b>				
				U.S. APPLICATION NO. (If known) 37 CFR 1.54 <b>107088314</b>
INTERNATIONAL APPLICATION NO. <b>PCT/FI00/00796</b>		INTERNATIONAL FILING DATE <b>20 September 2000</b>		PRIORITY DATE CLAIMED <b>20 September 1999</b>
TITLE OF INVENTION <b>Method For Determining A Candidate Cell For An Active Set</b>				
APPLICANT(S) FOR DO/EO/US <b>Oscar SALONAHU</b>				
<p>Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:</p> <ol style="list-style-type: none"> <li><input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li><input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li><input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</li> <li><input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</li> <li><input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))             <ol style="list-style-type: none"> <li><input checked="" type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</li> <li><input type="checkbox"/> has been transmitted by the International Bureau.</li> <li><input checked="" type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</li> </ol> </li> <li><input type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</li> <li><input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))             <ol style="list-style-type: none"> <li><input checked="" type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). (<b>see Reply to Written Opinion</b>)</li> <li><input type="checkbox"/> have been transmitted by the International Bureau.</li> <li><input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</li> <li><input type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li><input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</li> <li><input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). <b>Unexecuted</b></li> <li><input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</li> </ol> <p><b>Items 11. to 16. Below concern other document(s) or information included:</b></p> <ol style="list-style-type: none"> <li><input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</li> <li><input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</li> <li><input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment.             <ol style="list-style-type: none"> <li><input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment.</li> </ol> </li> <li><input type="checkbox"/> A substitute specification.</li> <li><input type="checkbox"/> A change of power of attorney and/or address letter.</li> <li><input checked="" type="checkbox"/> Other items or information (<i>specify</i>). PCT Publication Sheet, Int'l Preliminary Examination Report, Written Opinion, Reply to Written Opinion; Int'l Search Report, PCT Request, PCT Demand;</li> </ol>				

U.S. APPLICATION NO. (If known, see 37 CFR 1.53) <b>10,088,314</b>		INTERNATIONAL APPLICATION NO. <b>PCT/F100/00796</b>		ATTORNEY'S DOCKET NUMBER <b>4925-217PUS</b>	
17.[x]The following fees are submitted:					
<b>Basic National Fee (37 CFR 1.492(a)(1)-(5)):</b> Search Report has been prepared by the EPO or JPO ..... <b>\$890.00</b> International preliminary examination fee paid to USPTO (37 CFR 1.482) ..... <b>\$710.00</b> No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) ..... <b>\$740.00</b> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... <b>\$1040.00</b> International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) ..... <b>\$100.00</b>					
<b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b>				<b>\$</b>	<b>890</b>
Surcharge of <b>\$130.00</b> for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				<b>\$</b>	
Claims	Number Filed	Number Extra	Rate		
Total Claims	22 - 20 =	2	x <b>\$18.00</b>	<b>\$</b>	<b>36</b>
Independent Claims	5 - 3 =	2	x <b>\$84.00</b>	<b>\$</b>	<b>168</b>
Multiple dependent claim(s) (if applicable)			+ <b>\$280.00</b>	<b>\$</b>	
<b>TOTAL OF ABOVE CALCULATIONS =</b>				<b>\$</b>	<b>1094</b>
Reduction of 1/2 for filing by small entity, if applicable.				<b>\$</b>	
<b>SUBTOTAL =</b>				<b>\$</b>	<b>1094</b>
Processing fee of <b>\$130.00</b> for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				<b>\$</b>	
<b>TOTAL NATIONAL FEE =</b>				<b>\$</b>	<b>1094</b>
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by the appropriate cover sheet (37 CFR 3.28, 3.31). <b>\$40.00</b> per property				<b>\$</b>	
<b>TOTAL FEES ENCLOSED</b>					<b>\$1094</b>
				<b>Amount to be refunded:</b>	<b>\$</b>
				<b>charged:</b>	<b>\$</b>
a. [x]One check in the amount of \$ <u>1094</u> to cover the above fee is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. <u>03-2412</u> in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed. c. [x]The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>03-2412</u> . A duplicate copy of this sheet is enclosed.					
<b>NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive          (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.</b>					
SEND ALL CORRESPONDENCE TO <u>Michael C. Stuart</u> Cohen, Pontani, Lieberman & Pavane 551 Fifth Avenue, Suite 1210 New York, New York 10176			 <u>Michael C. Stuart</u> <u>Registration Number: 35,698</u> <u>March 14, 2002</u> Tel: (212) 687-2770		

10,088314  
JC10 Rec'd PCT/PTO 13 MAR 2002  
By Express Mail # EL489597407US · March 14, 2002

Attorney Docket # 4925-217PUS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re National Phase PCT Application of

Oscar SALONAHU

International Appl. No.: PCT/FI00/00796

International Filing Date: 20 September 2000

For: Method For Determining A Candidate Cell For:  
An Active Set

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents

Washington, D.C. 20231

BOX PCT

S I R:

Prior to examination of the above-identified application, amend the application as follows:

IN THE SPECIFICATION (As amended in the Preliminary Examination Report):

Page 1, before line 2, the paragraph beginning with "The invention relates", insert the following title:

--FIELD OF THE INVENTION--

Page 1, before line 5, the paragraph beginning with "Transmission diversity", insert the following title:

**--BACKGROUND OF THE INVENTION--**.

Page 4, before line 14, the paragraph beginning with "The object of the invention", insert the following title:

**--SUMMARY OF THE INVENTION--**.

Page 8, delete lines 32 to 33 (last two lines on page).

Page 9, before line 1, the paragraph beginning with "The invention will now", insert the following paragraph and title:

-- Other objects and features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are intended solely for purposes of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims.

**BRIEF DESCRIPTION OF THE DRAWINGS--**.

Page 9, before line 13, the paragraph beginning with "Above in conjunction", insert the following title:

**--DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS--**.

Page 13, after the last line, insert the following paragraph:

--Thus, while there have been shown and described and pointed out fundamental novel features of the present invention as applied to a preferred embodiment thereof, it will be understood that various omissions and substitutions and changes in the form and details of the devices described and illustrated, and in their operation, and of the methods described may be made by those skilled in the art without departing from the spirit of the present invention. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Substitutions of elements from one described embodiment to another are also fully intended and contemplated. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.--.

Page 14, line 1, delete "Claims" and insert therefor --What is claimed is:--.

IN THE CLAIMS (As amended in the Preliminary Examination Report):

Amended claims 1, 12, 14, 16 and 19 to read as follows:

1. A method (200, 300, 400) for determining a candidate cell for an active set, where  
-the quality factor of each cell in the active set is determined (202),  
-a quality factor of a test cell is determined (203), and

-the test cell is accepted (205) as a candidate cell for the active set, if an acceptance criterion, which defines a value as a limit for accepting a test cell, is fulfilled, characterized in that the acceptance criterion is selected (201) so that in the acceptance criterion a first limit value is equal to a second limit value multiplied with a finite number, wherein said first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first active set, said second limit value is for a certain second quality factor of a test cell and for a certain second set of quality factors, consisting of quality factors of cells in a second active set, and the first quality factor is equal to the second quality factor multiplied with the same finite number and the first set of quality factors is the same as a set formed of the quality factors belonging to the second set of quality factors multiplied with the same finite number.

12. A method for determining a cell to be removed from the active set, where
  - the quality factor of each cell in the active set is determined,
  - a rejection criterion is evaluated using the cell having the smallest quality factor as a test cell and a temporary set, which contains the cells of the active set except the cell having the smallest quality factor, and
    - the test cell is removed from the active set, if a rejection criterion, which defines a value as a limit for rejecting a test cell, is fulfilled, characterized in that the rejection criterion is selected so that in the rejection criterion a first limit value is equal to a second

limit value multiplied with a finite number, wherein said first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first temporary set, the second limit value is for a certain second quality factor of a test cell and for a certain second set of quality factors, consisting of quality factors of cells in a second temporary set, and the first quality factor is equal to the second quality factor multiplied with the same finite number and the first set of quality factors is the same as a set formed of the quality factors belonging to the second set of quality factors multiplied with the same finite number.

14. An arrangement (500) for determining a candidate cell for an active set comprising

- means (501) for determining a quality factor for a test cell and
- means (502) for determining quality factors for the cells in the active set, characterized in that it further comprises
  - means (503) for selecting an acceptance criterion, which defines a value as a limit for accepting a test cell and in which a first limit value is equal to a second limit value multiplied with a finite number, wherein said first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first active set, the second limit value is for a certain second quality factor of a test cell and for a certain second set of quality factors, consisting of quality factors of cells in a second active set, and the first quality factor is equal to the second quality factor multiplied with the same finite number and the first set of quality

By Express Mail # EL489597407US March 14, 2002

factors is the same as a set formed of the quality factors belonging to the second set of quality factors multiplied with the same finite number and

- means (504) for deciding about the acceptance of the test cell as a candidate cell for the active set using the acceptance criterion.

16. A mobile station (510) comprising

- means (501) for determining a quality factor for a test cell and

- means (502) for determining quality factors for the cells in the active set, characterized in that it further comprises

- means (503) for selecting an acceptance criterion, which defines a value as a limit for accepting a test cell and in which a first limit value is equal to a second limit value multiplied with a finite number, wherein said first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first active set, the second limit value is for a certain second quality factor of a test cell and for a certain second set of quality factors, consisting of quality factors of cells in a second active set, and the first quality factor is equal to the second quality factor multiplied with the same finite number and the first set of quality factors is the same as a set formed of a quality factors belonging to the second set of quality factors multiplied with the same finite number and

- means (504) for deciding about the acceptance of the test cell as a candidate cell for the active set using the acceptance criterion.

19. A network element (520) comprising

- means (501) for determining a quality factor for a test cell and

- means (502) for determining quality factors for the cells in the active set, characterized in that it further comprises



By Express Mail # EL489597407US · March 14, 2002

- means (503) for selecting an acceptance criterion, which defines a value as a limit for accepting a test cell and in which a first limit value is equal to a second limit value multiplied with a finite number, wherein said first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first active set, said second limit value is for a certain second quality factor of a test cell and for certain second set of quality factors, consisting of quality factors of cells in a second active set, and the first quality factor is equal to the second quality factor multiplied with the same finite number and the first set of quality factors is the same as a set formed of the quality factors belonging to the second set of quality factors multiplied with the same finite number and

- means (504) for deciding about the acceptance of the test cell as a candidate cell for the active set using the acceptance criterion.

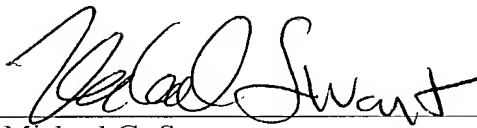
**REMARKS**

This preliminary amendment is presented to place the application in proper form for examination and to eliminate multiple dependency from the present claims. No new matter has been added. Early examination and favorable consideration of the above-identified application is earnestly solicited.

Attached hereto is a mark-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version with markings to show changes made".

Any additional fees or charges required at this time in connection with the application may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,  
COHEN, PONTANI, LIEBERMAN & PAVANE

By:   
Michael C. Stuart  
Reg. No. 35,698  
551 Fifth Avenue, Suite 1210  
New York, N.Y. 10176  
(212) 687-2770

14 March 2002

**AMENDMENTS TO THE SPECIFICATION AND CLAIMS SHOWING CHANGES**

**In the Claims:**

1. A method (200, 300, 400) for determining a candidate cell for an active set, where

- the quality factor of each cell in the active set is determined (202),
- a quality factor of a test cell is determined (203), and
- the test cell is accepted (205) as a candidate cell for the active set, if an acceptance criterion, which defines a value as [for] a limit for accepting a test cell, is fulfilled, characterized in that [such an] the acceptance criterion is selected (201) so that in the acceptance criterion a first limit value is equal to a second limit value multiplied with a finite number, wherein said first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first active set, said second limit value is for a certain second quality factor of a test cell and for a certain second set of quality factors, consisting of quality factors of cells in a second active set, and the first quality factor is equal to the second quality factor multiplied with the same finite number and the first set of quality factors is the same as a set formed of the quality factors belonging to the second set of quality factors multiplied with the same finite number.

12. A method for determining a cell to be removed from the active set, where

- the quality factor of each cell in the active set is determined,

1

,

---

- 3



factors is the same as a set formed of a quality factors belonging to the second set of quality factors multiplied with the same finite number and

- means (504) for deciding about the acceptance of the test cell as a candidate cell for the active set using the acceptance criterion.

19. A network element (520) comprising

- means (501) for determining a quality factor for a test cell and

- means (502) for determining quality factors for the cells in the active set, characterized in that it further comprises

- means (503) for selecting [such] an acceptance criterion, which defines a value [for] as a limit for accepting a test cell [,that] and in which a first limit value is equal to a second limit value multiplied with a finite number, wherein said first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first active set, said second limit value is for a certain second quality factor of a test cell and for certain second set of quality factors, consisting of quality factors of cells in a second active set, and the first quality factor is equal to the second quality factor multiplied with the same finite number and the first set of quality factors is the same as a set formed of the quality factors belonging to the second set of quality factors multiplied with the same finite number and

- means (504) for deciding about the acceptance of the test cell as a candidate cell for the active set using the acceptance criterion.

**Method for determining a candidate cell for an active set**

The invention relates in general to cellular networks. In particular the invention relates to soft handovers in cellular networks.

5 Transmission diversity refers to a situation where at least two transmitters are transmitting the same data flow to a receiver. For example, a mobile station may receive radio transmissions from two base stations of a cellular network simultaneously. One of the advantages of the transmission diversity is that if the quality or strength of one of the received radio transmissions decreases, the quality  
10 of some other received transmissions may still be high enough for receiving data reliably.

A situation where a mobile station communicates with more than one base stations simultaneously is called a soft handover. If necessary, for example to ensure a reliable data transmission, a mobile station may be communicating even most of the  
15 time with more than one base stations. In certain situations, when the signal of a certain base station is clearly stronger than the signals of other base stations, it may be enough to communicate with one base station only. There has to be a method for deciding with which base stations a mobile station communicates.

Transmission diversity and soft handovers can be supported, for example, in cellular  
20 networks that employ Code Division Multiple Access (CDMA) methods. Each transmitter may use its own spreading code in the downlink transmission, and a mobile station wanting to receive data from many transmitters processes the radio signal it receives with the spreading codes corresponding to the transmitters. The code sequences of different connections must be chosen so that they do not correlate  
25 and the code sequence of a specific connection has to autocorrelate. Those signals that have been spread using a code sequence that correlates with the code sequence used in receiving the seemingly white noise radio transmission are separated. The receiver has to know the transmitters code sequence and the code sequences must be synchronized. The bits in the code sequence are called chips.

Figure 1 presents a schematic drawing of a cellular network which comprises base stations 101a, 101b and 101c. In Figure 1, these base stations are all connected to a single radio network controller 102 and each base station is in the middle of a cell. Figure 1 presents one mobile station 110. The base stations transmit downlink data to mobile stations (arrows 120a, 120b and 120c) and receive uplink data from mobile stations (arrows 121a, 121b and 121c).

In general a base station may comprise many transmitters, each of which transmit a separate radio signal. In systems employing CDMA methods, the transmitters may use different spreading codes. Here term cell is used to refer either to a base station or, if a base station comprises many transmitters, to a transmitter. In a situation where a mobile station receives good quality downlink transmissions from many cells, it has to be decided which cell a certain mobile station communicates with.

Usually the cellular network informs the mobile station of the possible cells, for example, selected based on the location of the mobile station. The information about the nearest cells is called neighbor list. In a cellular network which employs CDMA methods, the neighbor list may comprise the downlink spreading codes of the cells. By taking the spreading codes listed in the neighbor list into use, the mobile station may separate the data flows sent to it from each cell from the radio signal it receives. The neighbor list of the mobile station 110 may comprise, for example, the cells corresponding to base stations 101a, 101b and 101c, assuming that a base station corresponds to one cell.

Usually a pilot signal is transmitted in each cell. This pilot signal carries no changing data, so it can be quite straightforwardly used in estimating the quality of the downlink radio transmission of a certain cell. A mobile station may, for example, estimate the quality of the radio transmission of all the cells in the neighbor list. A suitable parameter for quality estimation is, for example in a cellular system employing CDMA methods, the  $E_C/I_0$  ratio, where  $E_C$  is energy per chip and  $I_0$  is the interference. Any other parameter measuring the quality of the signal may also be used.

The cells with which a mobile station communicates form the active set of that mobile station. A radio network controller, for example, directs the downlink data heading to a certain mobile station, to all the cells in the active set. Correspondingly, the mobile station listens to the downlink transmissions of all the cells in the active set. For example, the cells corresponding to base stations 101a and 101b can form the active set of the mobile station 110.



When the mobile station changes its location or the qualities of the downlink radio transmissions of the neighboring cells change for some other reason, it may be necessary to modify the active set. A cell may be added to or removed from the active set, or a cell in the active set may be replaced with another cell. This replacement is usually called branch replacement.

There has to be a criterion for accepting a new cell for the active set. The CDMA2000 RTT description, for example, defines the following criterion for a test cell to be accepted to the active set. The cell may then be added to the active set or, in case of branch replacement, it may replace the worst quality cell in the active set.

10 If the quality factor, for example the  $E_C/I_0$  ratio, is marked with  $P_i$  for each cell  $i$  in the active set, an acceptance limit  $Q$  can be calculated by

$$Q = \max\{S \cdot 10\log_{10}(\sum P_i) + A, T\}$$

where  $S$ ,  $A$  and  $T$  are parameters. As can be seen from the formula for  $Q$ , the value of  $Q$  is expressed in dB and the quality factor  $P_i$  is a plain number. It is checked if a certain cell with quality factor  $P_T$  is a proper candidate for the active set by comparing  $10\log_{10} P_T$  to  $Q$ . If  $10\log_{10} P_T$  (i.e.  $P_T$  expressed in dB) exceeds  $Q$ , then the cell can be added, for example, to the active set. Parameter  $T$  ensures that even if the quality factors  $P_i$  of the cells currently in the active set are poor, a cell having  $P_T$  (expressed in dB) less than  $T$  is never accepted as a candidate cell.

20 There may be other conditions, for example that the active set may not be modified too frequently, that hinder the adding of a new cell to the active set. All neighboring cells not belonging to the active set, for example, may be tested each time the neighbor list changes, and the cells whose quality factor does exceeds the acceptance criterion may be considered to be added to the active set.

25 The problem with the current acceptance criterion is that it does not ensure proper acceptance decisions when the value of  $S$  is different from 0 or 1. Let us consider two examples, when the following values for the parameters are set:  $S = 2$ ,  $A = -6.0$  dB and  $T = -6$  dB. In the first example, the active set contains two cells, each of which has the quality factor value 1, i.e.  $P_1 = 1$  and  $P_2 = 1$ . The acceptance

30 limit in this example is  $Q = 0$  dB, i.e. a cell having a quality factor of 1 can be, for example, added to the active set. This is an acceptable decision, because the cell has the same quality factor as the cells in the active set.

In the second example the active set contains also two cells, and now the quality factors are  $P_1 = 3$  and  $P_2 = 3$ . The acceptance limit in this example is  $Q = 9.5$  dB. The quality factors of the cells in the active set are 5 dB, so a cell has to have a quality factor 4.5 dB higher than the cells in the active set to be accepted to the active set. Correspondingly, expressed in absolute values, a cell should have a quality factor  $P_C = 9.5$  to be accepted to the active set. Intuitively, the acceptance criterion should also in this second example produce the result that a test cell can be accepted to the active set if the quality factor of the cell is larger than 3.

The current acceptance criterion thus leads to situation where intuitively similar situations produce a different acceptance decision. A further problem with the acceptance criterion is that for an active set whose cells have the same quality factors, from here on called an uniform active set, the acceptance limit is not equal to the quality factor.

The object of the invention is to present a method for determining a candidate cell for the active set. A further object of the invention is to present a method where similar active sets and test cells produce the same acceptance decision. Further, it is advantageous that the method for determining a candidate cell accepts a cell whose quality factor is equal to the quality factor of an uniform active set.

The object of the invention is achieved by selecting the acceptance criterion so that it is indifferent to the absolute values of the quality factors.

A method according to the invention is a method for determining a candidate cell for an active set, where

- the quality factor of each cell in the active set is determined,
- a quality factor of a test cell is determined, and
- the test cell is accepted as a candidate cell for the active set, if an acceptance criterion, which defines a value for a limit for accepting a test cell, is fulfilled, and the method is characterized in that such an acceptance criterion is selected that a first limit value is equal to a second limit value multiplied with a finite number, wherein said first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first active set, said second limit value is for a certain second quality factor of a test cell and for a certain second set of quality factors, consisting of quality factors of cells in a second active set, and the first quality factor is equal to the second quality factor multiplied with the same finite number and the first set of quality factors is the same

as a set formed of the quality factors belonging to the second set of quality factors multiplied with the same finite number.

A method according to the invention is a method for determining a cell to be removed from the active set, where

- 5 - the quality factor of each cell in the active set is determined,
  - a rejection criterion is evaluated using the cell having the smallest quality factor as a test cell and a temporary set, which contains the cells of the active set except the cell having the smallest quality factor, and
  - 10 - the test cell is removed from the active set, if a rejection criterion, which defines a value for a limit for rejecting a test cell, is fulfilled,
- and it is characterized in that such a rejection criterion is selected that a first limit value is equal to a second limit value multiplied with a finite number, wherein said first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first temporary set,
- 15 said second limit value is for a certain second quality factor of a test cell and for a certain second set of quality factors, consisting of quality factors of cells in a second temporary set, and the first quality factor is equal to the second quality factor multiplied with the same finite number and the first set of quality factors is the same as a set formed of the quality factors belonging to the second set of quality factors
  - 20 multiplied with the same finite number.

The invention relates also to an arrangement for determining a candidate cell for an active set comprising

- means for determining a quality factor for a test cell and
- means for determining quality factors for the cells in the active set, which
- 25 arrangement is characterized in that it further comprises
- means for selecting such an acceptance criterion, which defines a value for a limit for accepting a test cell, that a first limit value is equal to a second limit value multiplied with a finite number, wherein said first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of
- 30 quality factors of cells in a first active set, the second limit value is for a certain second quality factor of a test cell and for a certain second set of quality factors, consisting of quality factors of cells in a second active set, and the first quality factor is equal to the second quality factor multiplied with the same finite number and the first set of quality factors is the same as a set formed of the quality factors
- 35 belonging to the second set of quality factors multiplied with the same finite number and

- means for deciding about the acceptance of the test cell as a candidate cell for the active set using the acceptance criterion.

A mobile station according to the invention comprises

- means for determining a quality factor for a test cell and
- 5 - means for determining quality factors for the cells in the active set, and it is characterized in that it further comprises
- means for selecting such an acceptance criterion, which defines a limit for accepting a test cell, that a first limit value is equal to a second limit value multiplied with a finite number, wherein said first limit value is for a certain first
- 10 quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first active set, the second limit value is for a certain second quality factor of a test cell and for a certain second set of quality factors, consisting of quality factors of cells in a second active set, and the first quality
- 15 factor is equal to the second quality factor multiplied with the same finite number and the first set of quality factors is the same as a set formed of the quality factors belonging to the second set of quality factors multiplied with the same finite number and
- means for deciding about the acceptance of the test cell as a candidate cell for the active set using the acceptance criterion.
- 20 The invention relates to a network element comprising
- means for determining a quality factor for a test cell and
- means for determining quality factors for the cells in the active set, which network element is characterized in that it further comprises
- means for selecting such an acceptance criterion, which defines a value for a limit
- 25 for accepting a test cell, that a first limit value is equal to a second limit value multiplied with a finite number, wherein said first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first active set, said second limit value is for a certain
- 30 second quality factor of a test cell and for a certain second set of quality factors, consisting of quality factors of cells in a second active set, and the first quality factor is equal to the second quality factor multiplied with the same finite number and the first set of quality factors is the same as a set formed of the quality factors belonging to the second set of quality factors multiplied with the same finite number and
- 35 - means for deciding about the acceptance of the test cell as a candidate cell for the active set using the acceptance criterion.

6a

In a method according to the invention, the quality factors of the cells in the active set are determined. Further, the quality factor of a test cell not in the active set but, for example, in the neighbor list is determined. The choice of the quality factors used in a method according to the invention is not restricted. The term accepting a  
5 test cell as a candidate cell for the active cell refers to a situation, where a mobile station or the cellular network notices that a certain cell has good enough quality factor, for example, to be added to the active set. The acceptance of a test cell as a candidate cell may trigger, for example, the transmission of the transmission quality reports from a mobile station to the cellular network. Thereafter the cellular network  
10 may decide whether the active set is modified.

In the method according to the invention, the acceptance criterion is selected so that it fulfills the following condition. The acceptance criterion  $Q'$  for a test cell having a quality factor  $P_T$  and for an active set having  $n$  cells, whose quality factors are  $P_1, P_2, \dots, P_n$ , is  $Q'(P_T, P_1, P_2, P_3, \dots)$ . The value  $Q'(P_T, P_1, P_2, P_3, \dots)$  is equal to the value of acceptance criterion for a test cell having a quality factor  $aP_T$  and for an active set having  $n$  cells, whose quality factors are  $aP_1, aP_2, \dots, aP_n$ . Here  $a$  is any finite scalar number. The condition for the acceptance criterion can be written as

$$\forall a \quad Q'(aP_T, aP_1, aP_2, aP_3, \dots) = Q'(P_T, P_1, P_2, P_3, \dots).$$

The quality factor of the test cell and the quality factors of cells in the active set are not restricted, the condition holds for any values of  $P_T$  and  $P_i$ , where  $P_i$  is the quality factor of cell  $i$  in the active set. An example of a acceptance criterion fulfilling the condition is the following criterion where geometric mean is employed

$$Q'(P_T, P_1, P_2, \dots): P_T > \sqrt[n]{\prod P_i}$$

because  $Q'(aP_T, aP_1, aP_2, aP_3, \dots)$  is

$$Q'(aP_T, aP_1, aP_2, \dots): aP_T > \sqrt[n]{\prod aP_i} = \sqrt[n]{a^n} \sqrt[n]{\prod P_i} = a \sqrt[n]{\prod P_i}.$$

If for a certain value of  $P_T$ ,  $Q'(P_T, P_1, P_2, P_3, \dots)$  is true, then  $Q'(aP_T, aP_1, aP_2, aP_3, \dots)$  is also true. In other words, if a test cell having quality factor  $P_T$  is accepted as a candidate cell for the active set whose cells have quality factors  $P_1$  and  $P_2$ , a test cell having quality factor  $aP_T$  is accepted as a candidate cell for the active set whose cells have quality factors  $aP_1$  and  $aP_2$ . It is possible to use only some of the quality factors of the cells in the active set in the acceptance criterion, but typically the quality factors of all cells in the active set are used.

In one embodiment of the invention said acceptance criterion involves a function, whose value depends at least on quality factors of first cells in the active set and on certain parameter values. Said acceptance criterion procudes a same value for said first quality factor of a test cell, said first set of quality factors and first parameter values as for said second quality factor of a test cell, said second set of quality factors and the same first parameter values, said first parameter values being any parameter values.

It may, however, be easier to normalized all the quality factors with a certain number and then use the normalized quality factors. The acceptance decision may, for example, be a function having the normalized quality factors as variables. The

normalization factor has to be chosen so that its relative value when compared to the quality factors of the cells in the active set is same for all active sets. The normalization factor may be, for example, the average of the quality factors of the cells in the active set.

- 5 It is also possible to use similar methods when deciding about removing a cell from the active set. In this case the cell in the active set having the smallest quality factor is compared to the rest of the active set. Usually the rejection criterion is selected somewhat higher than the acceptance criterion, in order to avoid frequently removing from the active set and adding to the active set a same cell. The  
10 acceptance and rejection criterion may employ same mathematical function and parameters, but the parameter values are selected in a proper way.

The diversity gain depends on the relative strengths (for example, quality factors) of the cells in the active set. The main advantage of the method according to the invention is that the acceptance decision depends on the relative sizes of the quality  
15 factors and does not pay attention only to the absolute values of the quality factors. The acceptance decisions thus reflect the changes in the diversity gain.

A further advantage of the method according to the invention is that when relative sizes of the quality factors are used, it is easier to predict how a certain acceptance criterion, for example a certain function, behaves. It is enough to study a limited  
20 number of examples when, for example, parameter values for an acceptance criterion are selected. Even a further advantage is that the current methods for determining a candidate cell for the active set can be quite easily updated to a method according to the invention. No further measurement results, for example, are needed that are currently available.

25 The method according to the invention may be carried out, for example, periodically. When a mobile station, for example, detects a new candidate cell for the active set, it may transmit a request for handover or a request for update of the active set to the cellular network. The method according to the invention may also be triggered by a certain event, for example, by the update of the neighbor list. The  
30 method according to the invention does not specify if the active set is modified after finding a candidate cell to the active set.

Further embodiments of the invention are described in the accompanying dependent claims.

The invention will now be described more in detail with reference to the preferred embodiments by the way of example and to the accompanying drawings where

- Fig. 1 shows a schematic drawing of the radio access network of a cellular system,
- 5 Fig. 2 shows a flowchart of method according to a first preferred embodiment of the invention,
- Fig. 3 shows a flowchart of method according to a second preferred embodiment of the invention,
- Fig. 4 shows a flowchart of method according to a third preferred embodiment of the invention, and
- 10 Fig. 5 shows a schematic drawing of an arrangement, a mobile station and a network element that employ a method according to the invention.

Above in conjunction with the description of the prior art reference was made to Figure 1. The same reference numerals are used for corresponding parts in the figures.

15

Figure 2 presents a flowchart of a method 200 according to a first preferred embodiment of the invention. In step 201 a proper acceptance condition is selected. In a method according to the invention, the acceptance criterion  $Q'$  has to be of form  $Q'(aP_T, aP_1, aP_2, aP_3, \dots) = Q'(P_T, P_1, P_2, P_3, \dots)$ , where  $P_i$  is the quality factor of cell  $i$  in the active set,  $P_T$  is the quality factor of the test cell, and  $a$  is a scalar. The acceptance criterion can be, for example, that the quality factor of the test cell needs to exceed the average of the quality factors of the cells in the active set

20

$$P_T > \frac{1}{n} \sum P_i,$$

where  $n$  is the number of cells in the active set. Linear combinations of the values  $P_i$  and a geometrical mean  $\sqrt[n]{\prod P_i}$  are examples of functions that can be used in the acceptance criterion  $Q'$  according to the first preferred embodiment of the invention.

25

In step 202 quality factors for the cells belonging to the active set are determined. This may happen, for example, so that a mobile station determines the  $E_C/I_0$  ratio for the pilot signals of the cells in the active set. In step 203 the quality factor of a test cell is determined. The test cell may be, for example a cell in the neighbor list that does not belong to the active set. If the acceptance criterion is true (step 204), and the test cell is accepted in step 205 as a candidate cell for the active set. If the quality factor is not large enough, then the test cell is rejected (step 206).

30



Figure 3 presents a flowchart of a method 300 according to a second preferred embodiment of the invention. In this method, the quality factors of the cells in the active set and the quality factor of the test cell are normalized by dividing them with a certain normalization factor  $P_n$ . The normalization factor has to be chosen for each active set so that its ratio to the quality factors of the cells in the active set is the same for all active sets, i.e. for an active set having quality factors  $P_1, P_2, P_3, \dots$  the normalization factor is  $P_n$  and for an active set having quality factors  $aP_1, aP_2, aP_3, \dots$  the normalization factor is  $aP_n$ . For example, the average of the quality factors of the cells in the active set may be used as a normalizing factor  $P_n$ , or the minimum quality factor or the maximum quality factor of the cells in the active set.

The advantage of using normalized quality factors is that the acceptance criterion  $Q'$  may have any functional form and it still obeys  $Q'(aP_T, aP_1, aP_2, aP_3, \dots) = Q'(P_T, P_1, P_2, P_3, \dots)$ . For example, the prior art acceptance limit

$$Q = \max\{S \cdot 10 \log_{10}(\sum P_i) + A, T\}$$

where  $S$ ,  $A$  and  $T$  are parameters can be modified to the following acceptance criterion  $Q'$

$$Q': \quad 10 \log_{10} \frac{P_T}{P_n} > \max\left\{S \cdot 10 \log_{10}\left(\sum \frac{P_i}{P_n}\right) + A, T - 10 \log_{10} P_n\right\}.$$

The values for this acceptance criterion are true (when  $P_T$  exceeds the condition) and false (when  $P_T$  does not exceed the condition).

In Figure 3, the flowchart of the method 300 starts with the same steps 201, 202 and 203 as method 200. A proper acceptance criterion is selected, the quality factors of the cells in the active set and the quality factor of the test cell is determined. Thereafter, in step 301 these quality factors are normalized with a normalization factor  $P_n$ . The acceptance criterion in step 302 is determined using the normalized quality factors, for example the functional form presented above may be used for  $Q'$ .

In step 303 it is checked if the value for the acceptance criterion is true, and if it is the test cell is accepted as a candidate cell for the active set in step 205. If the value for the acceptance criterion is false, the test cell is rejected in step 206.

Let us study further the method 300 according to the second preferred embodiment of the invention and the presented functional form for  $Q'$ . Consider two active sets and the parameter values  $A = -6.0$  dB,  $S = 2$  and  $T = -6.0$  dB. In the first active set

there are two cells whose quality factors are 1 and 1, and in the second active set the quality factors for the cells in the active set are 3 and 3. Let us choose the normalizing factor  $P_n$  as the average quality factor of the cells in the active set. The acceptance criterion becomes

$$5 \quad Q': \quad 10 \log_{10} \frac{P_T}{P_n} > \max\{0 \text{ dB}, -10.8 \text{ dB}\} = 0 \text{ dB}$$

indicating that in both examples the quality factor of the test cell has to be larger than the normalization factor for the test cell to be accepted as a candidate cell for the active set.

- Let us consider one further example using the same parameter values for  $A$ ,  $S$  and  $T$ .
- 10 The active set contains in this case two cells, whose quality factors are  $P_1 = 1$  and  $P_2 = 3$ . Let us study the effect of the normalization factor by trying three normalization factors:  $P_{n1} = P_{\max} = 3$ ,  $P_{n2} = P_{\text{ave}} = 2$  and  $P_{n3} = P_{\min} = 1$ . For the first normalization factor the acceptance criterion becomes

$$Q'_1: \quad 10 \log_{10} \frac{P_T}{P_{n1}} > \max\{-3.5 \text{ dB}, -10.8 \text{ dB}\} = -3.5 \text{ dB} \Rightarrow P_T > 0.45 P_{n1} = 1.3.$$

- 15 For the second and third normalization factors the acceptance criteria are

$$Q'_2: \quad 10 \log_{10} \frac{P_T}{P_{n2}} > \max\{0 \text{ dB}, -9 \text{ dB}\} = 0 \text{ dB} \Rightarrow P_T > P_{n2} = 2 \text{ and}$$

$$Q'_3: \quad 10 \log_{10} \frac{P_T}{P_{n3}} > \max\{6 \text{ dB}, -6 \text{ dB}\} = 6 \text{ dB} \Rightarrow P_T > 4.0 P_{n3} = 4.$$

- The choice of the normalization factor thus clearly affects the acceptance criterion. When using, for example, the minimum quality factor of the cells in the active set as a normalization factor, the criterion becomes more demanding than when, for
- 20 example, the maximum quality factor of the cells in the active set is chosen. By choosing the normalization factor properly it is thus possible to adjust the behavior of a method according to the second preferred embodiment of the invention. When using the maximum quality factor in normalization, more cells are accepted as candidate cells for the active set.

- 25 Figure 4 presents a flowchart of a method 400 according to a third preferred embodiment of the invention. In this method the quality factors of the cells in the active set and the quality factor of the test cell are normalized similarly as in method 300. Further, in this method the acceptance criterion is adjusted so that in a case,

where the active set contains cells which all have the same quality factor, a test cell is accepted as a candidate cell for the active set when its quality factor is larger than the quality factor of the cells in the active set.

As an example, let us again consider the acceptance criterion  $Q'$

$$5 \quad Q': \quad 10 \log_{10} \frac{P_T}{P_n} > \max \left\{ S \cdot 10 \log_{10} \left( \sum \frac{P_i}{P_n} \right) + A, T - 10 \log_{10} P_n \right\}.$$

When all cells in the active set have the same quality factor  $p$ , the sum of the quality factors is equal to  $np$ . A test cell having the same quality factor  $p$  should fulfill the following condition

$$10 \log_{10} \frac{p}{P_n} = \max \left\{ S \cdot 10 \log_{10} \frac{np}{P_n} + A, T - 10 \log_{10} P_n \right\}.$$

- 10 Further, let us first study parameters  $A$  and  $S$ , and choose  $T$  thereafter. This results in equation

$$10 \log_{10} \frac{p}{P_n} = S \cdot 10 \log_{10} \frac{np}{P_n} + A,$$

and the relation between  $A$  and  $S$  can be written as

$$A = (1 - S) \cdot 10 \log_{10} \frac{p}{P_n} - S \cdot 10 \log_{10} n.$$

- 15 If the normalization factor  $P_n$  is the average/maximum/minimum quality factor of the cells in the active set, for an active set containing cells whose quality factors are equal to  $p$  the normalization factor is  $P_n = p$ . The relation between  $A$  and  $S$  thus becomes

$$A = (1 - S) \cdot 10 \log_{10} \frac{p}{p} - S \cdot 10 \log_{10} n = -S \cdot 10 \log_{10} n.$$

- 20 If the normalization factor is not equal to  $p$  for an active set whose cells all have quality factor  $p$ , the first term also contributes to the relation. For example, if the number of cells in the active set is two (i.e.  $n = 2$ ), the relation between the parameter values is  $A = -3S$ . When  $n = 3$ , the relation is  $A = -4.8S$ . The value for parameter  $T$  can be chosen so that  $T < 0$ .

In method 400 in Figure 4, after the acceptance criterion has been selected in step 201 the number of cells in the active set is determined in step 401. In step 402 the acceptance criterion is adjusted for an uniform active set, where all cells have the same quality factor  $p$  similarly as explained above. The acceptance criterion may  
5 depend at least on the number of cells in the active set and on the choice of the normalization factor. After the acceptance criterion has been adjusted, the method 400 continues similarly as method 300 from step 202 onwards.

Figure 5 present an arrangement 500, a mobile station 510 and a network element 520 where a method according to the invention is implemented. The arrangement  
10 for determining a candidate cell for the active set comprises a test cell block 501, where the quality factor for a test cell is determined. It also comprises an active set block 502, where the quality factors for the cells belonging to the active cell are determined. It is advantageous to measure the quality factors of the cells belonging to the active set each time the quality factors are needed, but it is also possible to  
15 store the values in memory and update them, for example, periodically.

The arrangement 500 further comprises an acceptance criterion block 503, where the acceptance criterion is selected and possible adjusted. In the decision block 504 the quality factors of the test cell and of the cell belonging to the active set are used to evaluate the acceptance criterion. The blocks may be implemented, for example,  
20 using microprocessors and proper program code.

Figure 5 shows how the block of the arrangement may be located to more than one device. In Figure 5, the mobile station 510 comprises block 501 and 502, i.e. it determines the quality factors for the cells in the active set and for the test cell. It may, for example, measure the  $E_C/I_0$  ratio of the pilot signals of neighboring cells.  
25 The measurement results may be transferred to a network element 520 of the cellular network. This network element may be in charge of determining if the test cell is accepted as a candidate cell for the active set.

It is also possible that a mobile station comprises the whole arrangement 500, and when it detects a candidate cell for the active set, it informs the cellular network  
30 about the candidate cell and possibly about the quality factor of the candidate cell and about the quality factors of the cells in the active set. When selecting the cells for the active set in the uplink direction, a network element 520 may comprise the whole arrangement 500.

## Claims

1. A method (200, 300, 400) for determining a candidate cell for an active set, where
  - the quality factor of each cell in the active set is determined (202),
  - 5 - a quality factor of a test cell is determined (203), and
  - the test cell is accepted (205) as a candidate cell for the active set, if an acceptance criterion, which defines a value for a limit for accepting a test cell, is fulfilled, **characterized** in that such an acceptance criterion is selected (201) that a first limit value is equal to a second limit value multiplied with a finite number, wherein said
  - 10 first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first active set, said second limit value is for a certain second quality factor of a test cell and for a certain second set of quality factors, consisting of quality factors of cells in a second active set, and the first quality factor is equal to the second quality factor multiplied with
  - 15 the same finite number and the first set of quality factors is the same as a set formed of the quality factors belonging to the second set of quality factors multiplied with the same finite number.
2. A method according to claim 1, **characterized** in that said acceptance criterion involves a function, whose value depends at least on quality factors of first cells in
- 20 the active set and on certain parameter values, and in that said acceptance criterion produces a first limit value for said first quality factor of a test cell, said first set of quality factors and first parameter values, which first limit value is equal to a second limit value multiplied with the finite number, said second limit value being for said second quality factor of a test cell, said second set of quality factors and said
- 25 first parameter values, said first parameter values being any parameter values.
3. A method (300, 400) according to claim 1, **characterized** in that
  - the quality factor of the test cell and the quality factors of the cells in the active set are normalized (301) with a number having a predefined relative value compared to the values of the quality factors of the cells in the active set,
  - 30 - a value for the limit is determined (302) using the normalized quality factors of the cells in the active set and the normalized quality factor of the test cell and
  - the test cell is accepted (303, 205) as a candidate cell, if the acceptance criterion is fulfilled.

4. A method (300, 400) according to claim 3, **characterized** in that the quality factors are normalized using the largest quality factor of the quality factors of the cells in the active set.
5. A method (300, 400) according to claim 3, **characterized** in that the quality factors are normalized using the smallest quality factor of the quality factors of the cells in the active set.
6. A method (300, 400) according to claim 3, **characterized** in that the quality factors are normalized using the average quality factor of the quality factors of the cells in the active set.
7. A method (400) according to claim 1, **characterized** in that the acceptance criterion is such that for an active set where all the cells have a certain quality factor the limit is that certain quality factor.
8. A method according to claim 1, **characterized** in that the method is executed periodically.
9. A method according to claim 1, **characterized** in that the method is triggered by a certain event.
10. A method according to claim 1, **characterized** in that the candidate cell is added to the active set.
11. A method according to claim 1, **characterized** in that the cell having the worst quality factor in the active set is replaced with the candidate cell.
12. A method for determining a cell to be removed from the active set, where
  - the quality factor of each cell in the active set is determined,
  - a rejection criterion is evaluated using the cell having the smallest quality factor as a test cell and a temporary set, which contains the cells of the active set except the cell having the smallest quality factor, and
  - the test cell is removed from the active set, if a rejection criterion, which defines a value for a limit for rejecting a test cell, is fulfilled, **characterized** in that such a rejection criterion is selected that a first limit value is equal to a second limit value multiplied with a finite number, wherein said first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first temporary set, the second limit value is for a certain second quality factor of a test cell and for a certain second set of quality factors,

consisting of quality factors of cells in a second temporary set, and the first quality factor is equal to the second quality factor multiplied with the same finite number and the first set of quality factors is the same as a set formed of the quality factors belonging to the second set of quality factors multiplied with the same finite number.

13. A method according to claim 12, **characterized** in that said rejection criterion involves a function, whose value depends at least on quality factors of first cells in the temporary set and on certain parameter values, and in that said rejection criterion produces a first limit value for said first quality factor of a test cell, said first set of quality factors and first parameter values, which first limit value is equal to a second limit value multiplied with the same finite number, the second limit value being for said second quality factor of a test cell, said second set of quality factors and said first parameter values, said first parameter values being any parameter values.

14. An arrangement (500) for determining a candidate cell for an active set comprising

- means (501) for determining a quality factor for a test cell and
- means (502) for determining quality factors for the cells in the active set, **characterized** in that it further comprises
- means (503) for selecting such an acceptance criterion, which defines a value for a limit for accepting a test cell, that a first limit value is equal to a second limit value multiplied with a finite number, wherein said first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first active set, the second limit value is for a certain second quality factor of a test cell and for a certain second set of quality factors, consisting of quality factors of cells in a second active set, and the first quality factor is equal to the second quality factor multiplied with the same finite number and the first set of quality factors is the same as a set formed of the quality factors belonging to the second set of quality factors multiplied with the same finite number and
- means (504) for deciding about the acceptance of the test cell as a candidate cell for the active set using the acceptance criterion.

15. An arrangement according to claim 14, **characterized** in that said acceptance criterion involves a function, whose value depends at least on quality factors of first cells in the active set and on certain parameter values, and in that said acceptance criterion produces a first limit value for said first quality factor of a test cell, said first set of quality factors and first parameter values, which first limit value is equal

to a second limit value multiplied with the finite number, the second limit value being for said second quality factor of a test cell, said second set of quality factors and said first parameter values, said first parameter values being any parameter values.

5 16. A mobile station (510) comprising

- means (501) for determining a quality factor for a test cell and  
- means (502) for determining quality factors for the cells in the active set, **characterized** in that it further comprises

10 - means (503) for selecting such an acceptance criterion, which defines a limit for accepting a test cell, that a first limit value is equal to a second limit value multiplied with a finite number, wherein said first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first active set, the second limit value is for a certain second quality factor of a test cell and for a certain second set of quality factors,  
15 consisting of quality factors of cells in a second active set, and the first quality factor is equal to the second quality factor multiplied with the same finite number and the first set of quality factors is the same as a set formed of the quality factors belonging to the second set of quality factors multiplied with the same finite number and

20 - means (504) for deciding about the acceptance of the test cell as a candidate cell for the active set using the acceptance criterion.

17. A mobile station according to claim 16, **characterized** in that said acceptance criterion involves a function, whose value depends at least on quality factors of first cells in the active set and on certain parameter values, and in that said acceptance  
25 criterion produces a first limit value for said first quality factor of a test cell, said first set of quality factors and first parameter values, which first limit value is equal to a second limit value multiplied with the finite number, the second limit value being for said second quality factor of a test cell, said second set of quality factors and said first parameter values, said first parameter values being any parameter  
30 values.

18. A mobile station according to claim 16, **characterized** in that it is a mobile station of an Universal Mobile Communication System.

19. A network element (520) comprising

- means (501) for determining a quality factor for a test cell and



- means (502) for determining quality factors for the cells in the active set, **characterized** in that it further comprises
  - means (503) for selecting such an acceptance criterion, which defines a value for a limit for accepting a test cell, that a first limit value is equal to a second limit value  
5 multiplied with a finite number, wherein said first limit value is for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of cells in a first active set, said second limit value is for a certain second quality factor of a test cell and for a certain second set of quality factors, consisting of quality factors of cells in a second active set, and the first quality  
10 factor is equal to the second quality factor multiplied with the same finite number and the first set of quality factors is the same as a set formed of the quality factors belonging to the second set of quality factors multiplied with the same finite number and
  - means (504) for deciding about the acceptance of the test cell as a candidate-cell  
15 for the active set using the acceptance criterion.
20. A network element according to claim 19, **characterized** in that it is a network element of the radio access network of the Universal Mobile Communication System.
21. A network element according to claim 20, **characterized** in that it is a Radio  
20 Network Controller.
22. A network element according to claim 19, **characterized** in that said acceptance criterion involves a function, whose value depends at least on quality factors of first cells in the active set and on certain parameter values, and in that said acceptance criterion produces a first limit value for said first quality factor of a test  
25 cell, said first set of quality factors and first parameter values, which first limit value is equal to a second limit value multiplied with the finite number, the second limit value being for said second quality factor of a test cell, said second set of quality factors and said first parameter values, said first parameter values being any parameter values.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
29 March 2001 (29.03.2001)

PCT

(10) International Publication Number  
**WO 01/22763 A1**

(51) International Patent Classification<sup>7</sup>: **H04Q 7/38**

(21) International Application Number: **PCT/FI00/00796**

(22) International Filing Date:  
20 September 2000 (20.09.2000)

(25) Filing Language: **English**

(26) Publication Language: **English**

(30) Priority Data:  
19992005 20 September 1999 (20.09.1999) **FI**

(71) Applicant (for all designated States except US): **NOKIA NETWORKS OY [FI/FI]; P.O. Box 300, FIN-00045 Nokia Group (FI).**

(81) Designated States (national): **AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.**

(84) Designated States (regional): **ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).**

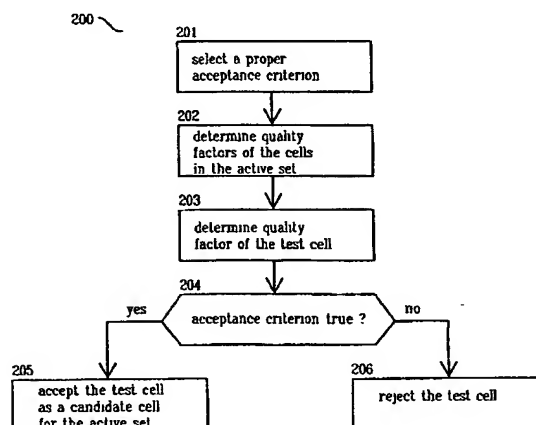
**Published:**  
— *With international search report.*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(72) Inventor; and  
(75) Inventor/Applicant (for US only): **SALONAHU, Oscar [FI/FI]; Oksasenkatu 4bA 8, FIN-00100 Helsinki (FI).**

(74) Agent: **BERGGREN OY AB; P.O. Box 16, FIN-00101 Helsinki (FI).**

(54) Title: **METHOD FOR DETERMINING A CANDIDATE CELL FOR AN ACTIVE SET**



(57) Abstract: A method (200, 300, 400) according to the invention is a method for determining a candidate cell for an active set, where the quality factor of each cell in the active set is determined (202), a quality factor of a test cell is determined (203), and the test cell is accepted (205) as a candidate cell for the active set if an acceptance criterion is fulfilled. The method is characterized in that the acceptance criterion is selected (201) so that for a certain first quality factor of a test cell and for a certain first set of quality factors, consisting of quality factors of the cells in a first active set, the acceptance criterion has the same value as for a certain second quality factor of a test cell and for a certain second set of quality factors, consisting of quality factors of cells in a second active set, when the first quality factor is equal to the second quality factor multiplied with any finite number and the first set of quality factors is the same as a set formed of the quality factors belonging to the second set of quality factors multiplied with the same finite number. The invention relates also to an arrangement, to a mobile station and to a network element where decisions about accepting a cell as a candidate cell for the active set are done.

WO 01/22763 A1

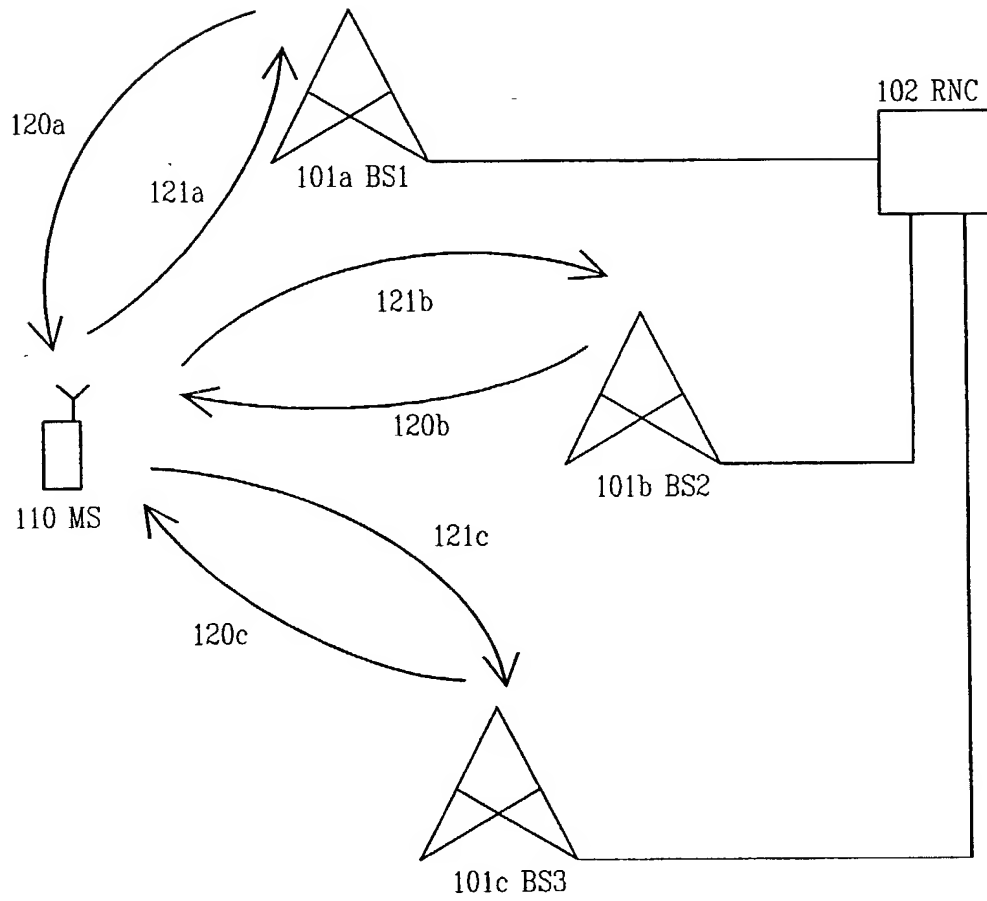


FIG. 1 PRIOR ART

2/5

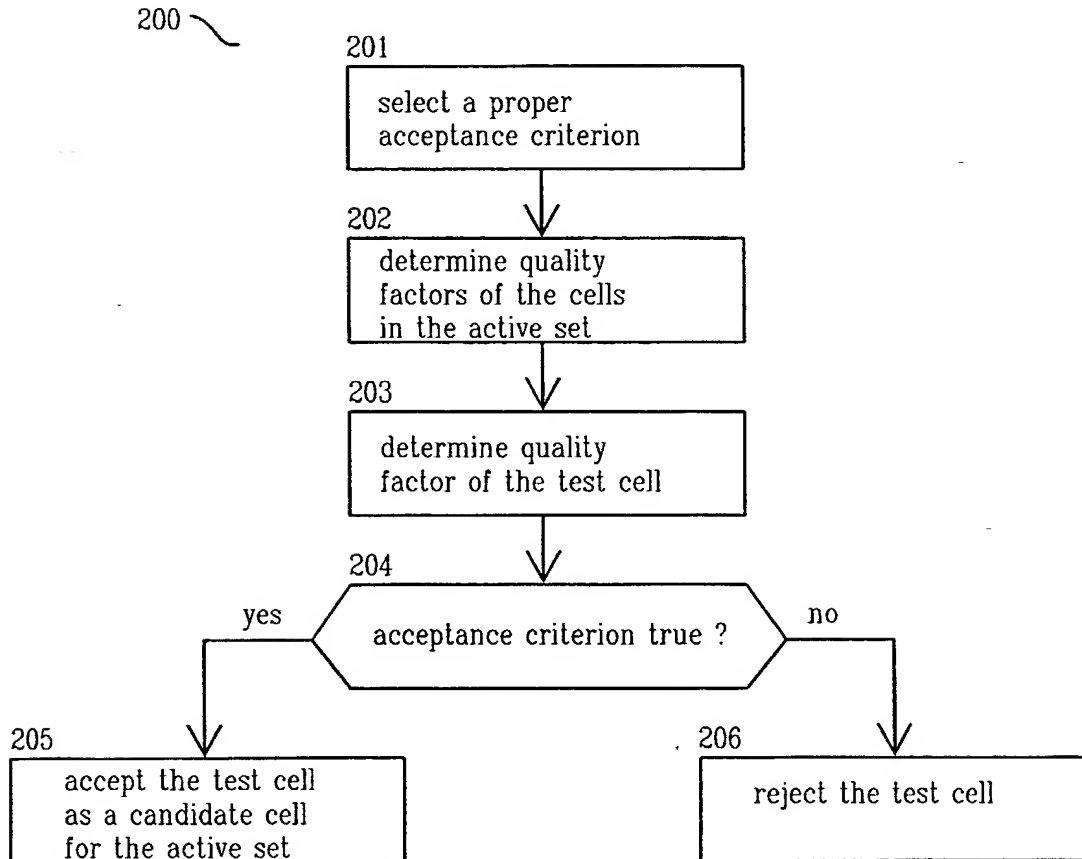


FIG. 2

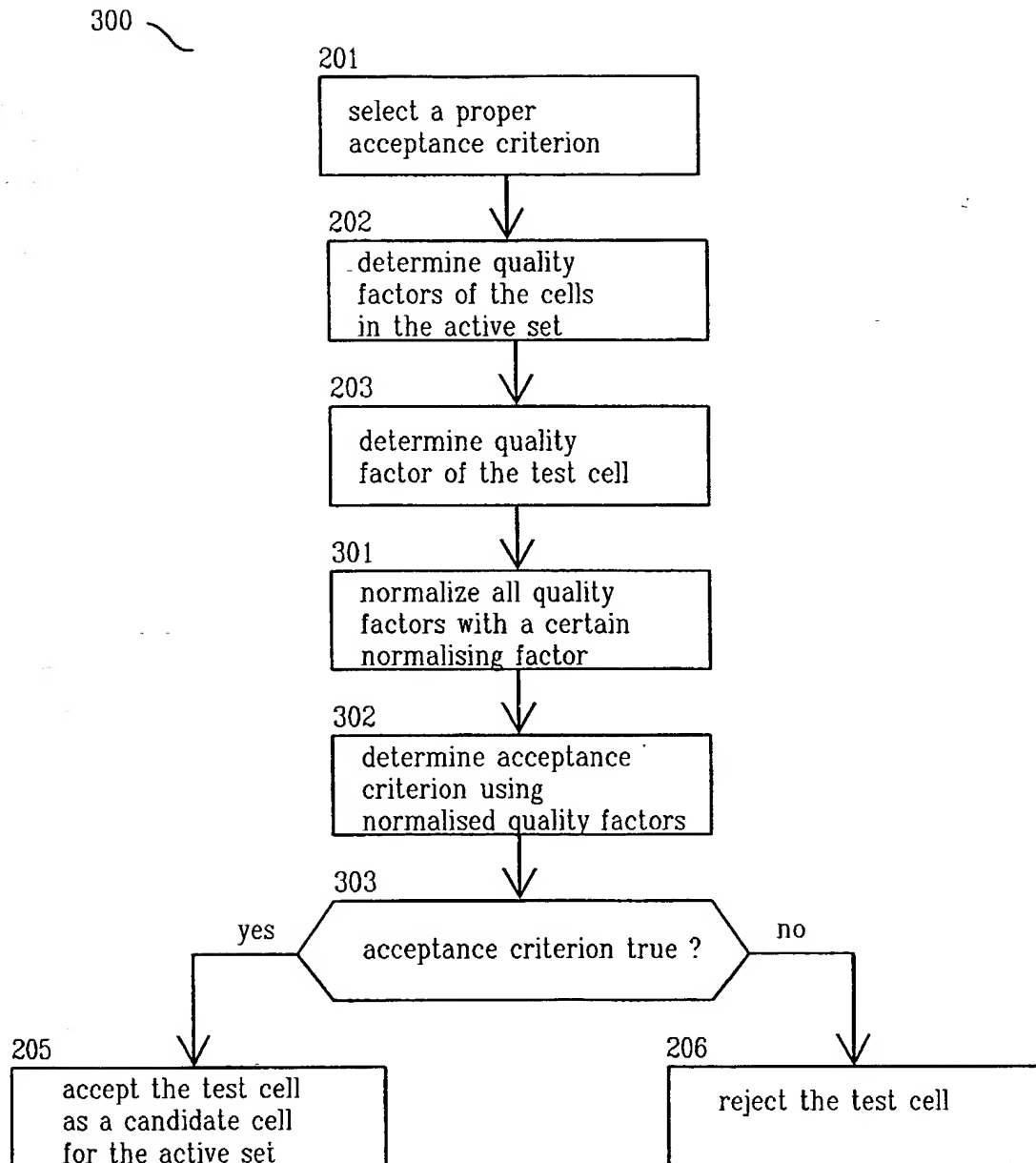


FIG. 3

4/5

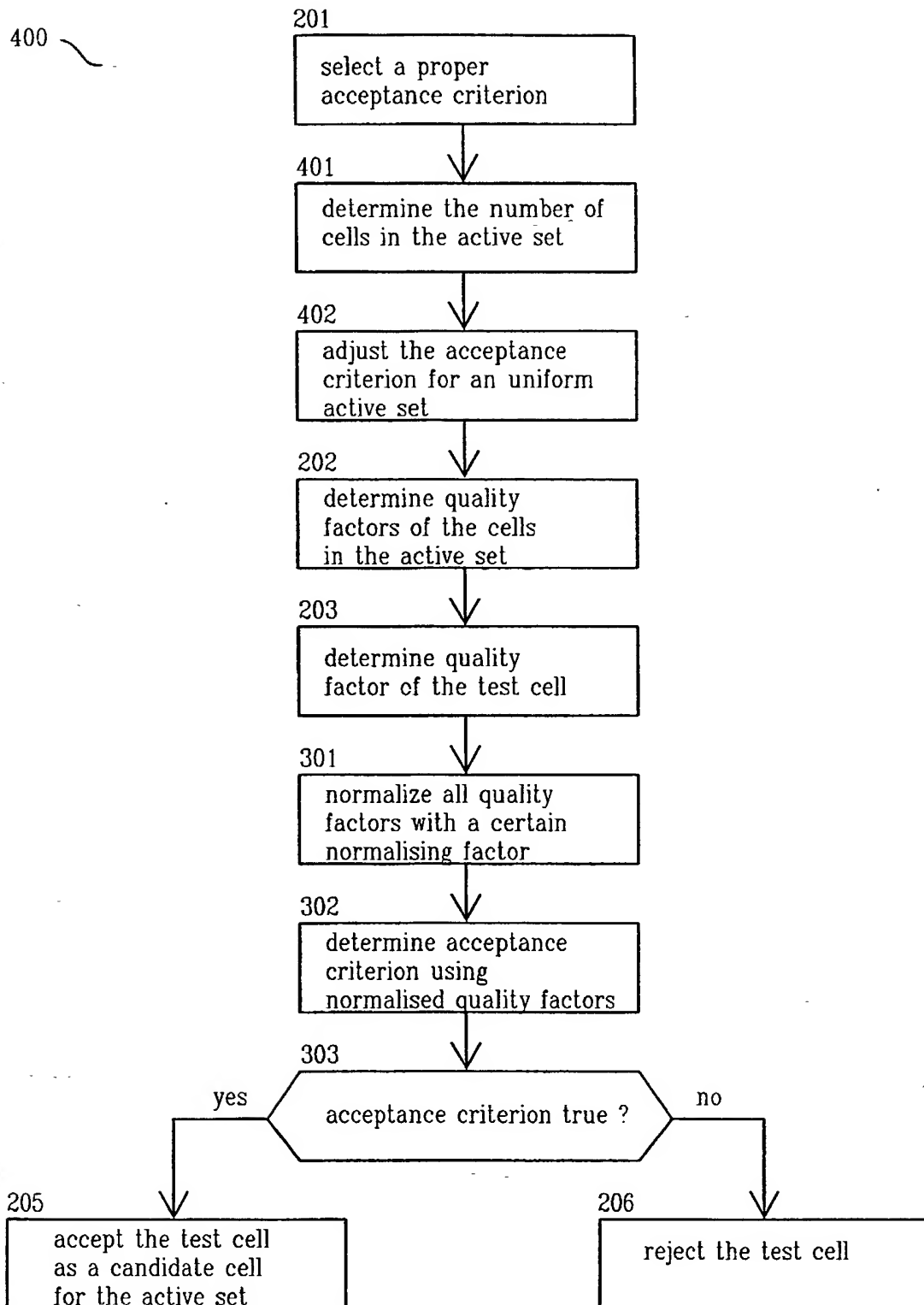


FIG. 4

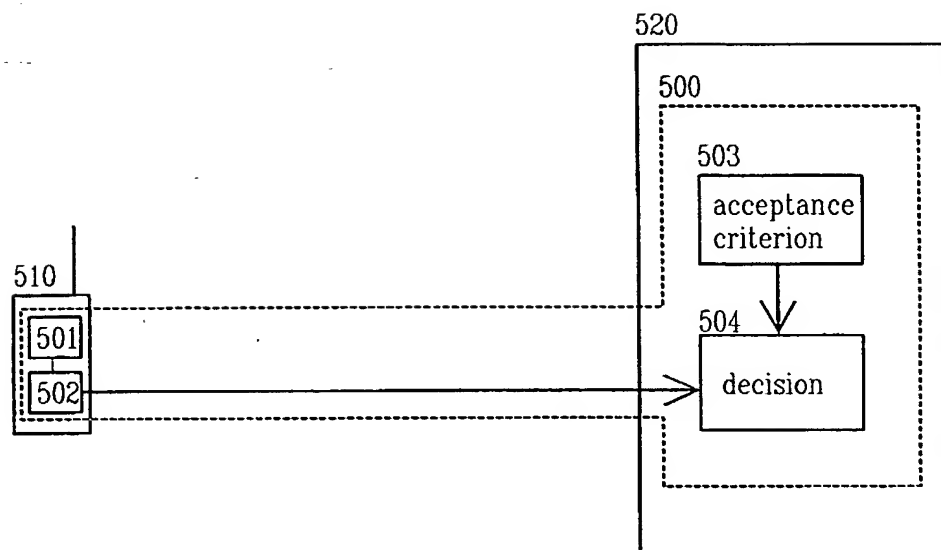


FIG. 5

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

## METHOD FOR DETERMINING A CANDIDATE CELL FOR AN ACTIVE SET

the specification of which (check only one item below)

[ ] is attached hereto

U) was filed as United States application

Serial No. \_

on \_\_\_\_\_

and was amended

on \_ (if applicable).

[x] was filed as PCT international application

Number PCT/FI00/00796

on 20 September 2000

and was amended under PCT Article 19

on \_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of the application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

PRIOR FOREIGN/PCT APPLICATIONS AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

Country (if PCT, indicate "PCT")	Application Number	Date of Filing (day, month, year)	Priority Claimed Under 35 U.S.C. 119	
Finland	19992005	20 September 1999	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
PCT	PCT/FI00/00796	20 September 2000	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO



**Combined Declaration for Patent Application and Power of Attorney (Continued)**  
 (Includes Reference to PCT International Applications)

 Attorney's Docket No  
**4925-217PUS**

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112. I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

**PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120**

U.S. APPLICATIONS		STATUS (check one)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED
PCT APPLICATIONS DESIGNATING THE U.S.				
PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)		
PCT/FI00/00796	20 September 2000		X	

**POWER OF ATTORNEY:** As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute the application and transact all business in the Patent and Trademark Office connected therewith (*List name and registration number*)

MYRON COHEN, Reg. No. 17,358; THOMAS C. PONTANI, Reg. No. 29,763; LANCE J. LIEBERMAN, Reg. No. 28,437; MARTIN B. PAVANE, Reg. No. 28,337; MICHAEL C. STUART, Reg. No. 35,698; KLAUS P. STOFFEL, Reg. No. 31,668; EDWARD WEISZ, Reg. No. 37,257; VINCENT M. FAZZARI, Reg. No. 26,879; JULIA S. KIM, Reg. No. 36,567; ALFRED FROEBRICH, Reg. No. 38,887; ALFRED H. HEMINGWAY, JR., Reg. No. 26,736; KENT H. CHENG, Reg. No. 33,849; YUNLING REN, Reg. No. 47,019; ROGER S. THOMPSON, Reg. No. 29,594; BRICE FALLER, Reg. No. 29,532; DAVID J. ROSENBLUM, Reg. No. 37,709; TONY CHEN, Reg. No. 44,607; ELI WEISS, Reg. No. 17,765; TEODOR J. HOLMBERG, Reg. No. 50,140.

Send correspondence to:


Michael C. Stuart  
 Reg. No. 35,698  
Cohen, Pontani, Lieberman & Pavane  
551 Fifth Avenue, Suite 1210  
New York, New York 10176

Direct Telephone calls to  
 (name and telephone number)  
Michael C. Stuart  
(212) 687-2770

201	FULL NAME OF INVENTOR	FAMILY NAME <u>SALONAHU</u>	FIRST GIVEN NAME <u>Oscar</u>	SECOND GIVEN NAME
	RESIDENCE - CITIZENSHIP	CITY <u>Helsinki</u>	STATE OR FOREIGN COUNTRY <u>Finland</u> <b>FIX</b>	COUNTRY OF CITIZENSHIP <u>Finland</u>
	POST OFFICE ADDRESS	POST OFFICE ADDRESS <u>Oksasenkatu 4bA 8</u>	CITY <u>Helsinki</u>	STATE & ZIP CODE/COUNTRY <u>FIN-00101 Finland</u>
202	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE - CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

Attorney's Docket No.  
4925-217P1 S

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201 	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE 15/04/2002	DATE	DATE